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ABSTRACT

A theoretical situation-person-interactions model of learning and performance is presented, and applications of the model through the Instrumental Language Functions (ILF) approach with preschool normal and older variously handicapped children and adults are described. The model is graphically depicted and discussed according to such aspects as sensations which are basic to learning; sensations and long term memory (LTM); LTM and coding of sensation; LTM coding, and short term memory (STM); and applications to general learning, memory, and language disturbances of retarded persons. The ILF approach is then discussed in terms of teaching subprocesses in concept learning (e.g., selective associations) and corresponding verbal expressions (e.g., differences and similarities), conceptual systems (e.g., which shape or color); and supporting children's emotional/motivational dispositions to build self-concept. Additional aspects discussed include influence of the ILF on coding in perception, analytic coding, skill learning, concept learning, STM, thinking and choosing acts, teaching, and learning of school subjects. Approximately one-third of the paper consists of examples of the ILF approach to teaching. (MC)

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A SYSTEM OF CONSTRUCTS USED TO DEFINE LEARNING IN DEVELOPMENT; FURTHER USED TO DEFINE DISTURBANCES OF LEARNING IN AND TO DEFINE CORRESPONDING "TREATMENTS" OF PERSONS WHO MANIFEST RETARDED INTELLECTUAL DEVELOPMENT

A N I L F - A P P R O A C H

A contribution to the EASE Congress, held in BRÜSSELS in November, 1982, by

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NB ! Recommendation for reading: Start by reading sections III.1 to III.4. Read thereafter the paper as a whole.

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A SYSTEM OF CONSTRUCTS USED TO DEFINE LEARNING IN DEVELOPMENT; FURTHER USED TO DEFINE DISTURBANCES OF LEARNING IN AND TO DEFINE CORRESPONDING SPECIAL EDUCATIONAL "TREATMENTS" OF PERSONS WHO MANIFEST RETARDED INTELLECTUAL DEVELOPMENT

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INTRODUCTION: LEARNING IN PSYCHOLOGICAL DEVELOPMENT

Psychological development can be defined by two main processes: 1) Biological maturation or growth, taking place fairly independent of the experiences made by a person. Maturation and failure of maturation is the domaine in which medicine can contribute to development. 2) Learning, based upon the experiences made by and stored in the person.

Both maturation and learning can be disturbed and thereby cause a psychological developmental retardation. Only the learning process can be influenced by teaching or instruction, however; that is, teaching can be defined as the professional arrangement of optimal learning conditions. Special education can accordingly be defined as the providing appropriate learning conditions for persons with different kinds of learning disturbances.

Consistent with this definition, the psychology of learning, and especially that of learning class concepts and corresponding verbal skill components - learning instrumental language functions (ILF) - has proved to be powerful tools in my and my associates' educational work with intellectually retarded children; with children facing more specific problems in learning to read and write "natural" language and learning mathematical language; with pre-school or low-MA children, etc.

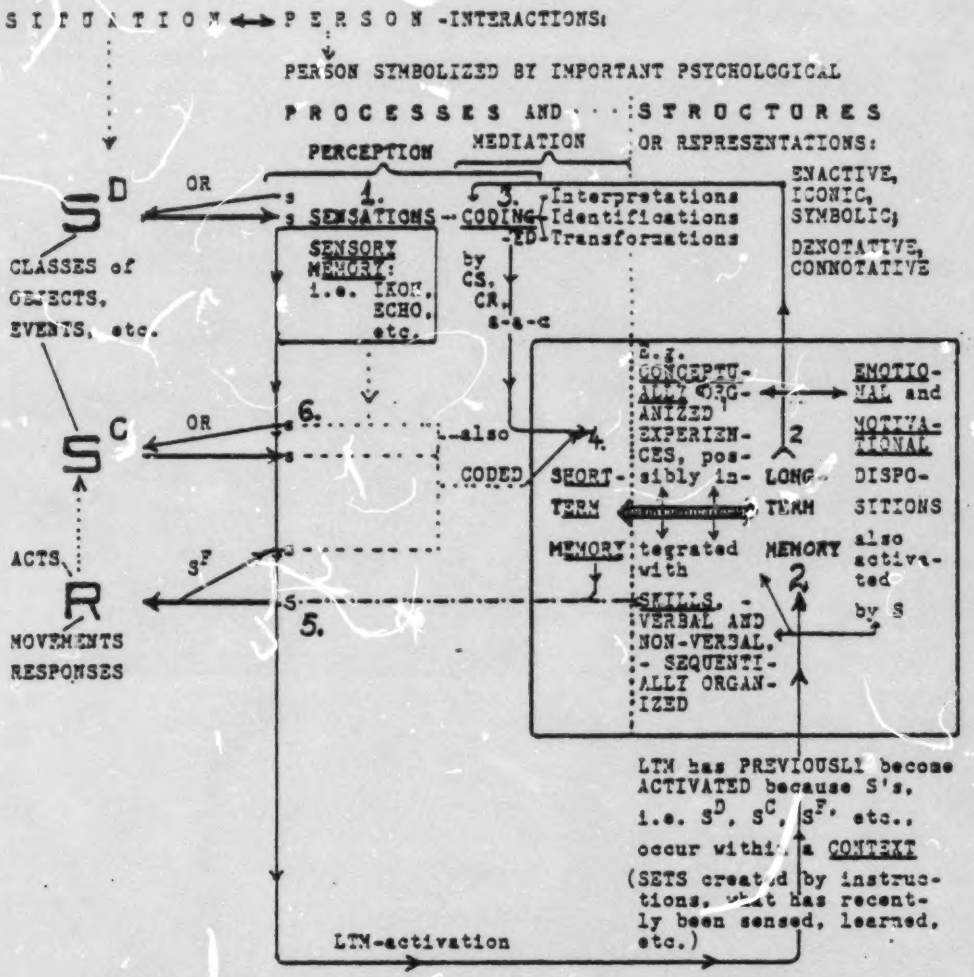
I A SYSTEM OF CONSTRUCTS AND INTERRELATIONS BETWEEN CONSTRUCTS, USED TO DEFINE LEARNING IN DEVELOPMENT: A THEORETICAL MODEL OF PERSON-SITUATION-INTERACTIONS DURING LEARNING AND PERFORMANCE

I.1 The theoretical model outlined:

A person who learns by interactions ($\rightleftharpoons$) with situational components (S^D, S^C, $R \rightarrow S^F$), can be depicted by analogy or

modeled as has been done in figure 1, below:

Fig.1



OR - orienting responses or acts: Turning head, following contours with eyes, oral orientational acts, manipulations, etc.
S^F - feedback stimuli from the person's own acts.
S^D - discriminative stimuli; S^C - stimuli consequent upon the response
CS - coding systems; CR - coding responses; s-a-c - stimulus-as-coded
† CONCEPTUALLY ORGANIZED - class concepts, organized into conceptual SYSTEMS by means of language skills.

I.11 Sensations basic to experiences in learning

Learning does basically take place in terms of sensations (1. in fig.1) of many kinds (s); that is, including sensations originating in muscles and joints during action (OR←s; R←s in the figure). Sensations, in turn, are parts of experiences or perception . Sensations can sometimes be stored

for a very short time - and in "raw" or un-processed form - in what has been called sensory memory (SM in fig.1).

I.12 Sensations and Long-Term Memory (LTM)

Sensations and their persistence beyond the stimulation interval in SM can evidently a) contribute to the building up of a person's long-term memory (2.: LTM in fig.1) or permanent representation of experiences. If stimuli are somehow familiar to the person, sensations and SM can b) also contribute to the activation of LTM-stored experiences previously made by the person.

I.13 LTM and the coding of sensations: Perception

When activated, LTM-contents can contribute to a coding of sensations (3. in fig.1). Thus an object (e.g. a house) can be coded in terms of an object class name, corresponding to the class concept of houses; a specific event (e.g. writing) can similarly be coded in terms of an event-class name, corresponding to a learned concept of an event-class; an attribute (e.g. a shape, or a colour, or a size, etc.) can be coded in terms of an attribute class name and possibly by the corresponding super-ordinate class name (yellow colour, bowed shape, large size, placed besides, etc.); a written word can be coded by reading it and by associating it's conceptual meanings, etc.

In each of the given examples, which can be many, many times multiplied, the coding must be performed in terms of 1) a concept and possibly also a conceptual system; i.e., in terms of the person's knowledge or cognitions of similarities between different members of a class of phenomena; and 2) the verbal or language skills underlying the act - the coding "response" - of thinking, articulating or publicly saying a word, a phrase, a sentence, etc. Such conceptual structures and language skills - in this paper also referred to as instrumental language functions (ILFs) - are indicated

as necessary LTM-contents in figure 1, therefore.

Coding of sensations can also take place in terms of activated feelings or emotions, if feelings have been associated - in the person - with the actual words, things, attributes, etc.; and accordingly LTM-stored in the form of emotional dispositions towards phenomena or classes of phenomena (e.g."I'm afraid of snakes"). Similarly can motivational dispositions towards classes of phenomena ("I would like to have ---; -- to do ---", etc.) be activated by sensations and thereafter be used to code them (see LTM in fig.1).

I.14 LTM, coding and Short-Term Memory (STM)

After having become coded, sensed stimuli can be stored in short-term memory (STM, 4. in fig.1); i.e. a memory for recently coded sensations. STM is a limited memory in two senses: a) In the number of coding units or"chunks" stored (MILLER, 1956: 7±2 units); and b) in the time interval until forgetting usually occurs by "displacement".

STM is important in being necessary in order to stay within a context; e.g., in order to understand the presently read words in terms of those previously read. STM can be maintained by "rehearsal" of coding reactions (CR in fig.1); and it can be extended by using super-ordinate coding units; e.g., by using names for super-ordinate concepts in a system of concepts.

When SM and STM - both to be conceived of as processes - for a specific set of information occurs repeatedly - it can be anticipated that they will pass into LTM-store, which can be understood as a permanent, many-facetted structure; i.e., consisting mainly of skills, conceptual structures and dispositions as organizational units.

I.15 Mediating processes

The processes of analytic coding (coding the same phenomenon by means of two or more different coding systems and cor-

responding coding responses), short-term memory as an activation of LTM-contents, and a possible thinking before choosing acts, can probably all be sub-ordinated the construct of mediation (see the fig.); they can accordingly be labeled mediational processes (e.g. FEUERSTEIN, 1980; KENDLER & KENDLER, 1962; NYBORG, 1970, 1971, 1978).

I.2 Inter-relations between constructs

It has been or can be demonstrated that LTM-stored experiences in terms of skills, concepts and dispositions towards known phenomena can contribute

1) to an effective utilization of SM; i.e., by effective coding before SM-decay;
2) to perception by providing different bases for coding; i.e., mainly
   2.1 in terms of conceptual organizations, further organized into rules, principles, laws and other propositions by verbal skills;
   2.2 in terms of different kinds of skills, providing a basis for performing both observable acts and hidden coding "responses";
   2.3 in terms of dispositions for becoming emo-tionally activated and for becoming motivated by the sensed stimuli;
3) - through coding - contributing to STM-rehearsal and STM-extention;
4) contribute in terms of skills to the performances of manifested acts - to behavior;
5) to the coding of behavioral consequences (S^C) as either wanted (positive) or not wanted (negative).
6) They are necessary, also, in order to compare, elaborate upon and thereby think about past experiences; and to anticipate future events based upon regularities occurring in series of past experiences.

I.3 Derived educational or instructional objectives

From what has recently been pointed out, following important instructional objectives or tasks can be stated: Optimal arrangement of learning conditions must be provided for

a) learning many kinds of automatized, serially ordered skills, being the LTM-bases for acting in many different ways; i.e., for the skill components of competence under-

lying a person's self-respect, self-confidence, independence, etc.; and thereby, basic to the learning person's positive self-concept;

b) for learning the bases for understanding and use of language symbols and for adequate thinking; i.e., class concepts and conceptual hierarchies (systems, structures) which, by means of language skills can be organized into propositions (rules, principles, laws, definitions of class similarity, descriptions of specific members of classes (Brüssels as belonging to the classes of towns and capitals), etc.).

c) for learning supporting rather than disrupting emotional and motivational dispositions; i.e., dispositions which can be assumed to facilitate a favorable development.

II THE MODEL APPLIED TO DEFINE IMPORTANT AND GENERAL LEARNING AND MEMORY DISTURBANCES IN RETARDED INTELLECTUAL DEVELOPMENT : RETARDED CONCEPTUAL AND LANGUAGE SKILL LEARNING (i.e., INADEQUATE ILF) AND LEARNING ACCOMPANYING, UNFAVORABLE EMOTIVE DISPOSITIONS

Development can be retarded because of failures to maturate. This problem can not be solved by educational or instructional means, however.

Psychological development can be retarded for many and different reasons; e.g., retarded by stimulus deprivations of many kinds, by sensory deficits, by the "blocking" of "input channels" by unfavorable emotional and motivational dispositions, by poor coding and subsequent short-term processing of information, by poor storage due to brain damages, etc.

Below normal intellectual functioning as measures by general tests of intelligence can be the result. Correspondingly low IQ and MA, then, can be interpreted to reveal a disturbance of conceptual learning and LTM (JENSEN, 1970; NYBORG, 1980,2); and disturbances in the learning of corresponding language skills (SPREEN, 1965, 1966). Un-favorable emotional and motivational dispositions toward learning situations will

almost without exceptions be the consequence.

Since most developmental tasks and educational disciplines imply 1) the learning of skills, corresponding to different kinds of language symbols; and 2) to learn concepts and conceptual systems, constituting the most important meaning components of language (NYBORG, 1982,1,3), low intelligence test functioning is usually paralleled by a disturbance of "general adaptation" (GROSSMAN, 1973).

The described LTM-contents insufficiencies of retarded persons can explain the following disturbances revealed in behavioral manifestations:

II.1 Reported disturbances of perception

Disturbances of perception have been derived from shortcomings in copying "behavior" by Gestalt psychologists. Perceptual problems - problems of attention - have been revealed in two-choice discrimination learning studied by ZEAMAN & al. Similar problems are derived from inadequate performances in verbally instructed discrimination tasks by LURIA & al.; and inadequate perceptual analysis has been inferred from failures to learn concepts, by NYBORG (1971).

Since the multiple coding or perceptual analysis process seems to be disturbed (NYBORG, 1981,2,3,4), the conditions for informations storage also are unfavorable, according to CRAIK & LOCKHART (1972) and NYBORG (1971). Thus, the"depth" or flexibility of analysis, assumed to facilitate adequate storage, is correspondingly impaired in retarded persons.

III.2 Reported disturbances of short-term memory (STM)

Disturbances of STM have been inferred from a kind of memory span data by ELLIS (1970) and was explained as a failure to utilize adequate "rehearsal strategies" by him. A poor STM has also been inferred from data on use of redundancy and clustering in recall by several investigators, thus indicating a failure to organize information by means of adequate coding units (NYBORG, 1981,2).

II.3 Reported inadequateness of motivational structure

The model of person-situation-interactions can also be used to explain reported in-adequateness of motivational dispositions or structures (CROMWELL, 1963; ZIEGLER, 1966) and reported behavioral in-adequateness (e.g. BIJOU, 1966).

III DEVELOPMENTAL INSTRUCTION: A CONCEPT AND LANGUAGE SKILL TEACHING MODEL, DERIVED FROM TASK- AND SUB-PROCESS-ANALYSES, THROUGH 15-16 YEARS SUCCESSFULLY USED BY MANY TEACHERS TO TEACH BASIC CONCEPTUAL SYSTEMS, INTEGRATED WITH CORRESPONDING LANGUAGE SKILLS: IMPROVING INSTRUMENTAL LANGUAGE FUNCTIONS (ILF)

III.1 Introduction

Based upon theoretical analyses and empirical studies: A model for teaching concepts, integrated with language skills, and by language skills further organized into conceptual systems, propositions in general, principles, laws, rules, etc., has been developed and repeatedly tested through many years (e.g. NYBORG, 1971, 1978, 1,2,; 1980,1, 1981,4, 1982, 2 and 3).

The model focusses 1) upon teaching the analysed sub-processes in concept learning (selective associations, selective generalizations, and selective discriminations) and corresponding verbal expressions (e.g., things similar or different in having large size, being placed first in a row, etc.); 2) It also focusses upon teaching conceptual systems and their language skill counterparts as an LTM-basis for analytic perception and for "depth of analysis" (which shape, which colour, which size relation, number, which "place" relation, which substance ?, etc.); as an LTM-basis also for organized coding and rehearsal, supposed to extend STM. Finally 3) the model focusses upon teaching in such a way that supporting emotional and motivational dispositions can replace dis-organizing ones. Thus a positive self-concept, based upon different kinds of learned competence, is a main objective of instruction.

This ILF teaching model (eg., NYBORG, 1981,4) has been used within many contexts to increase children's learned readiness and corresponding freedom to learn in the future; i.e., to improve their capacity for transfer in terms of the perceptual analysis (multiple coding) involved in learning almost every task; further on, to improve learning rate and memory in many tasks, and thus increase also the capacity for thinking, based upon what has been learned and remembered.

The teaching referred to has taken place within many different experimental and natural school settings. Thus, it has been used to teach or instruct intellectually normal pre-school children (low MA and corresponding pre-operationality); to teach educable retarded children in special schools (IQs in the interval 50 to 70); to teach trainable mentally retarded children in and outside institutions for severely retarded persons; to teach children with disturbances in learning to read and write and to learn mathematical language in "normal" school; to teach hearing impaired and primarily emotionally disturbed children, etc. (NYBORG & al., 1980,1; NYBORG,(ed.), 1982,2).

This wide application has been possible, of course, since the teaching model concerns central and basic human psychological structures and processes: That is, language skills and the conceptual bases for understanding and using language symbols.

In a planned two-year research project, once again supported by the Norwegian Research Council for Science and Humanities, the teaching model will be used in a prophylactic attempt to prevent or reduce short-comings in children with IQs in the interval between approximately 70 to 90 who come to attend "normal" schools. It is particularly the conceptually based understanding components of language functions, involved in thinking and problem solving, that will be attacked by means of the teaching model and the rationale that lies behind it. This time it will be used in teaching children

in the last half year of preschool age and in the 1.5 first years in primary school; that is, children approximately between 6.5 and 8.5 years in Norway.

III.2 The main objectives of teaching ILF reviewed and extended

III.21 What is a class concept ? And a conceptual system ? And how should they be related to skills ? And how are ILF related to emotional and motivational dispositions ?

A class concept can be defined as a person's learned and LTM-(Long-Term Memory-) stored knowledge of "partial" similarities within classes of different phenomena; and of differences between members and not-members of given classes; i.e., classes of things and events, classes of relations between and within things and events, classes of attributes, of numbers in groups, etc.

Class concepts can be communicated by consistently naming or labeling different class members by the same class name or symbol: "This is a (member of the class of) tree, horse, boat, plant, large things, green colours, bowed shape, number of five," etc. Or the class concept can be non-verbally communicated by using or in other ways acting towards class members in such a way that another person can infer that the actual class membership is known by the person.

Thus, both non-verbal and verbal skills ("surface structures") are needed in order to be a able to communicate conceptual knowledge or meanings ("deep structures"): I.e. 1) Concepts are necessary in order to understand class symbols (e.g. words, signs, numbers, etc.) heard and read; and 2) class concepts are needed in order to be able to name class memberships in spoken and written expressions or "messages": Thus, regardless of which kind of symbol - learned in terms of language skills; - the corresponding conceptual meanings are indispencible and important components of the language functioning (ILF).

However, the most reliable evidence of complete concept

learning is observed when the person - in addition - is able to implicitely and explicitely describe similarities within members of classes; and describe also how class members can be different and are different from non-members, belonging to related classes which can easily be confused with the actual class. That is, described by means of language skills of different kinds.

Conceptual systems

However, when a person after learning is able to describe, not only how different members of a class (e.g., plants) are similar; but also how they are different from other classes (e.g., from animals, constituting another main category of living beings), and how sub-classes (of plants) differ, the person manifests that he has reliably learned a conceptual system, sub-ordinated a high-level concept name (PLANTS).

This applies also to the more fundamental or basic conceptual systems (of colour, taste, smell, shape, surface structure, substance, size, number of groups, location or place, etc.) to which we shall return later. The latter systems are fundamental, since they can be - and probably must be - used to learn more complex tasks, including more complex concepts and conceptual systems.

ILF and emotional and motivational dispositions

Words, however, also name classes of feelings or emotions; and classes of motives: "I want to do something; or have something", f.ex. And further: Words name classes of incentives, those things and events a person know, can think of, and therefore can be motivated to approach, to avoid, or to escape next time they occur; or wants to displace by attack.

And negative and positive incentive-values are often obtained or learned by the simultaneous occurence of sensed emotional and motivational autonome reactions, and experiences originating in other sources of stimulation (e.g. symbols of different kinds). In this "classical conditioning"

way, emotional and motivational dispositions can be tied to other kinds of experiences, when they are stored in memory (LTM in fig.1, page 4). Possibly tied also to learning situations and the teachers who arrange them, when learning either succeeds or fails.

Instrumental language functions (ILF)

It can be seen that ILF - or Instrumental Language Functions - then, refers 1) to different kinds of language skills (speech perception, speech, reading, and writing, related to different kinds of symbols); and 2) to their common conceptual meanings and to the more person-related emotional and motivational meaning components. They are instrumental in serving perception and thereby further learning, in thinking, short-term-memory, and in the choice of acts and performance of verbal acts.

And when different persons have both language skills and their conceptual meaning components in common, they have a remarkable instrument for communication and for communicative sociability at hand.

III.22 How do ILF influence coding in perception ?

The word coding refers to the fact that perception is not taking place in terms of sensations, only. Perception denotes a process which also is significantly influenced by the experiences previously made by, "processed" and stored in a person's long-term memory (LTM). Thus, when you read this paper, you do that, of course, in terms of sensations; but also by coding rows of letters, words, sentences, propositions, signs, etc., in terms of your reading skills; further, in terms of the conceptual and other meanings which probably are integrated with different kinds of word-representations, grammatical word-forms, etc. in your LTM.

Since most words[1] symbolize classes of phenomena, the most

1 E.g. number digits also symbolize classes, while letters usually symbolize or represent language sounds.

important LTM-basis for understanding or coding, their meanings are their conceptual meanings. And only when they are similarly learned and conceptually understood by both the writer ("sender") and the reader ("receiver"), a proper communication can occur. This, of course, relates also to other kinds of symbols; i.e., mathematical symbols, symbols in "second" languages, geographical symbols in maps, etc.

However, a similar process of coding by conceptual meanings can be assumed to take place when hearing spoken symbols, when touching "braille", when seing manual signs, etc. A coding by uttered or thought words (signs) and conceptual meanings seems to take place also as coding or mediational "responses" to non-verbal stimuli; i.e., to things and events, to their relations and attributes, etc.

Thus, you can continually code the things around you by assigning them memberships of classes; i.e., the classes of different walls, chairs, tables, doors, windows, curtains, substances used, colours, shapes, etc., all possibly named by the respective words - if you want to. This notion of perception as an increasingly"categorizing"process, involved in the coding of sensations by class concepts and corresponding class names, is of course the one re-cognized by HEBB (1949), by BRUNER (1957), and others.

Analytic coding - decentration

When one single object or event can be coded or classified by a person in terms of different verbal "responses" and by corresponding concepts and conceptual systems, an analytic coding can be said to have occured. Or, it is also possible to say that a set of abstractions has been performed by the person.

This, of course, is related to the less precisely defined "decentration", in PIAGET's system of constructs. The analytic coding can be shown to be a "mechanism" of transfer to most learning situations, including skill learning and to further concept learning (NYBORG, 1982, 1-3).

Analytic coding in skill learning

Consider this example from learning the skills of reading or writing: If a person has learned what is necessary to code - or analyze - the word lamp in terms of sequential concepts (first, second, etc. in a row), and to code each letter by the corresponding sound-production, that would help him in performing the skill of reading and copying that word.

Or an example from an even earlier stage of such skill learning: If the letter a can be analyzed as consist-ing of two part-shapes, in certain ways related to each other (a bowed or round shape, placed to the left of and touching the lower part of a rectilinear shape in vertical position), such analytic coding can mediate exact learning of and memory for a corresponding verbal skill.

Analytic coding in concept learning

Or consider another example from a large "population" of tasks: If many and different members of the class of balls (object-class) are analyzed or multiply coded by a child in terms of shape concepts, colour concepts, substance concepts, size concepts, function or use concepts, etc., the similarities between all balls can from such experiences be selected and the corresponding class concept of balls can be learned.

III.23 How do ILP influence short-term memory (STM) ?

"Laboratory" testing of STM: STM denotes a short-term memory for coded units. The units must be chosen among those already well learned by the person, therefore. And they are arranged in a sequence supposed to be unknown by the person. In laboratories and in several tests this means that sequences of number words, digits, consonant letters, conceptually unrelated words, etc., are used. That is, a sequence is presented only once, and the person is instructed to repeat it immediately after - short time after - the presentation.

In such"laboratory" testing only 6-7 coding units can usually be remembered.

Daily life STM-functions: In daily school life STM can function differently when f.ex. a child attempts to repeat correctly something "new" when given the opportunity:"Repeat (accomodate, imitate) this proposition after me: "All these groups (counted and pointed out) are similar in having a number of four elements or things".

The child must - in order to succeed with that task - be able to code and rehearse the proposition in terms of language skills (speech perception → speech) and possible conceptual meanings of single words, in the first place. If the proposition meaning has been understood in terms of previous learning, the proposition can be reconstructed based upon that. If not, only a minor number of words can usually be repeated as an"echo".

Or consider another example: "Repeat these words after me: "Seven, five, six, eight; ship, car, train, airplane; yellow, blue, red, green; cottage, house, garage." This list and similar lists of words can easily be remembered if they become coded in terms of language skills and conceptual meanings; further on, are"rehearsed" and organized coded by means of four super-ordinate class names (number words, names of transports, colours, and buildings) into four higher-order units. From these units, most of the words in such a list can usually be reconstructed (NYBORG, 1981,2).

Thus, STM depends upon an effective coding in terms language skills and conceptual meanings, when such coding is possible. Secondly, determined by rehearsal and organized coding into larger conceptual units or systems, while that is possible. In daily life STM is very important because it permits a person to stay within a context; i.e., to code the present in terms of what has recently taken place, the next item in a flow of events similarly coded in terms of the past, etc.

III.24 How do ILF involve in thinking and the choice of acts ?

LTM-stored skills - often learned by exercise or training through long time - underly the performance of acts; i.e., the act of saying or writing a word, the act of dancing, the act of reading, the act of playing a game or a music instrument, etc., etc.

However, when a person is faced with a situation (fig.1), her or his conceptual knowledge is often necessary in order to choose or select the correct act to be performed; e.g., choose the correct word to say, after sensation or thinking; choose the correct dance steps, after having coded the music rhythmes by the concept of tango rhythmes, etc. Thus, the choice must often be based upon an exact coding of situations in terms of concepts and language skills (ILF); and the processing of information obtained in this way, can continue by means of a process which more properly should be called thinking, when perception is no more possible.

By thinking in terms of remembered words, often organized into propositions, and the corresponding conceptual and larger-scale meanings (VYGOTSKY, 1962: Internalized speech), experiences from different times of a persons life can be compared and thereby re-organized. In this way learning can take place also without immediate perception and action.

III.25 ILF in teaching and learning school subjects

Each school subject or discipline can be said to consist of of a set of symbols, ordered by a syntax, and a corresponding set of defined concepts (KING & BROWNELL, 1966; NYBORG, e.g. 1982, 1,3). This applies to most disciplines within and outside school. In some subjects, concepts are organized by means of symbols to conceptual structures (or conceptual systems or hierarchies). The latter applies to the classifications of animals in zoology, of plants in botanics, of substances in chemistry, etc.

Symbols must usually be learned in terms of language skills.

However, in learning language and other skills, sequences of events have to be analyzed or coded in terms of sequential concepts and corresponding words (places in a row), and in terms of a sample of events or "elements" (e.g., movements, sounds, letters, words, etc.); and since letters are symbols for sounds and sound productions, they must be coded by sound productions in reading; and sounds, thought or produced, must be coded by written letters, in writing.

Thus, both propositions, words and single letters must be multiply coded or analyzed in order to become properly learned. When learning the smallest graphical units, the letters, they must be analyzed in terms of part shapes, place-relations and size-relations between part shapes, positions of shapes, number of part shapes, sequence of writing part shapes, etc. (see also p.16).

As has been pointed out, such conceptual systems - of shape, colour, place- and size-relations, positions, sequence, substance, etc. - are fundamental or basic, not only to the learning of skills; but also to the learning of concepts at different levels of a system or hierarchy of concepts.

It can be of value, therefore, to distinguish between fundamental conceptual systems, some of which are recently listed, and derived conceptual systems, which depend upon a persons learning and utilizing the more fundamental systems (in classifications in grammar, in zoology, in physics and chemistry, in botanics, etc.).

However, the fundamental conceptual systems, which can be supposed to be basic in learning both skills and concepts at "higher" or more complex levels, are usually not taught. They are supposed to be intuitively (PIAGET) or spontaneously (VYGOTSKY) "formed" by the child in daily life interactions with environments.

Unfortunately, not all children do "form" the necessary fundamental concepts; nor do they integrate them, in the age period 7-11 of "concrete operations" - into conceptual sys-

tems (or cognitive structures, as PIAGET labels them).

Thus, in schools, when teachers are trying to teach large "buildings of knowledge", without a good fundament and without the necessary instruments, neither the fundament nor the building become of great value for the owner.

In the following section, it can be seen how a concept and language skill (ILF-) teaching model has been used to "build up" or teach fundamental and instrumental conceptual systems: I.e., concerning

RELATIONS within and between things and events, i.e., the conceptual systems of SIZE-relations, PLACE-relations, WEIGHT-relations, TEMPERATURE-relations, NUMERICAL relations, etc.;

ATTRIBUTES of things and events; i.e. shape, colour and brightness , taste, smell, the substance used to make them, different relational systems, also used to describe attributes, etc.;

NUMBER in groups of things and events, in advance ordered in terms of object-class and event-class names, and including units of measurement.

III.3 The ILF teaching model examplified

III.31 Sub-processes in concept learning: The selective generalization (or conservation) process (SG)

Concepts have been defined as learned and thereby LTM-stored knowledge - within persons - of similarities between different members of classes of phenomena; a knowledge also of how the members are different, within classes, and how they are different from non-members of the observed or remembered class.

Thus, class members are not "the same" or"totally similar". They are only in certain "relevant" aspects similar. The "relevant aspects" must be both discovered or analytically coded and selected from a larger sample of aspects, therefore. Thats is, in order for the person to refind them in every

new member of that class.

The process of re-discovering something partially known or similar in new things and events, can accordingly be denoted selective generalization; and this process of selective generalization can - during teaching - be mediated by the verbal expression "similar in"; that is, similar in parts, in shape, in colour, in having bowed shape, in having the number of ten, in having small size, when related to something else, etc. The reader can probably remember that PIAGET tested conservations by phenomena being "similar in mass or volume, similar in number,"etc. And the selective generalizations of analysed relations have also been given a separate name in research (transposition).

In some reports, the expression selective generalization has even been replaced by that of "transfer of learning". And selective generalization is certainly the"mechanisme" of transfer, mediated by concept utilization.

III.32 Sub-processes in concept learning: The selective discrimination (SD) process

When members of classes are learned and can be coded also as different, and further different from non-members of the actual class, they must necessarily have been perceived as different (discrimination) and also recognized or recalled as different (discrimination learning).

But again is it correct to say - also of non-members - that they seldomly are totally different from members; only in certain respects are they different or dissimilar. And again must "relevant aspects" be selected, after an analytic coding performed by the person, therefore.

Thus a selective discrimination process must also be prepared and arranged for in the teaching of class concepts; and it can be mediated by the verbal expression "not similar" or "dissimilar in " (size, number, colour, shape, parts, etc.).

III.33 Sub-processes in concept learning: Analytic coding in perception (de-centration) - a pre-requisite for selectivity

Now, two sub-processes of concept learning[1] have become identified and pointed out; that is, selective generalization and selective discrimination. They must be elaborated or prepared for during the teaching of concepts, therefore.

A third process has only implicitely been pointed out; that is, the analytic coding, permitting the person to attend to the different aspects - of things and events - which must be kept in mind in order to select the relevant aspects for generalization and discrimination, respectively.

This process can adequately take place in concept identification tasks, only when a set of fundamental conceptual systems have been learned and can be applied to new tasks, allowing the learner to ask himself questions like the following: "Which colour ? Which shape ? Which parts ? Which number of parts ? Which relations between parts ?, etc. And this process of analytic coding (or perceptual analysis) can probably be coordinated to the process denoted de-centration, by PIAGET.

III.34 Sub-processes in CL: Analytic coding, followed by selective associations (accomodations and generalizing assimilation)

During the teaching → learning such fundamental conceptual systems, the analytic coding and resulting selectivity must take place simultaneously with other processes, therefore. Thus, in order to be able to selective generalize "something" and selectively discriminate "something" from "other things", this "something" must have been learned by the person in the first place.

This initial or first learning process to be arranged for has been labeled selective associations, in the teaching

1 A penetrating analysis of concept learning tasks and concept learning processes has been performed in NYBORG, 1978, 1. The analysis has been only partially repeated and reformulated in later works (e.g.NYBORG,1978.2, 1981,4, etc.).

model. And it corresponds to a combination of accomodation and generalizing assimilation, in the terminology of PIAGET.

It can be started by presenting a representative and "abstracted" member of the class taught. If the class consisted of "all lines being similar in having rectilinear shape", the first member can be presented by drawing a red-coloured recti-linear shape in vertical position ; i.e., by means of a ruler as instrument or tool.

Then a "conversation" between the teacher and each member of the group can start:"I know that you all have learned to use colour names correctly. You, Peter, can therefore describe which colour this line or shape has." Peter: "It has red colour" (an assimilation). "You said that both correct and nicely" would then be an adequate consequence to give Peter dependent upon that description.

"Now I'm going to teach you something that you probably have not had the opportunity to learn. (An accomodation or imitation is necessary, therefore). Therefore, I will not ask, in the first place; but rather tell you what to say. Look at this line again; we can also say that"it has recti-linear shape". Can you repeat that after me, Alice ?" (Alice is chosen because she usually easily can repeat sentences.) Alice: "It has rectilinear shape"."That was a correct and exact repetition", would possibly follow as a consequence. "Now, you may describe it Peter." --- "And you, Bob", etc.

After that, rectilinear shapes in different positions, of different lengths, of different bredths, of different colours, etc., are drawn and correspondingly described. And the pupils should make recti-linear shapes by means of rulers and correspondingly describe what they have made.

Recti-linear shapes should also be sought for in edges or contours of things, in letters, in number symbols, etc., and each time described:"It (this edge of the pencil, part of the letter, etc.) has recti-linear shape".

All this is done, not only in order to make possible a "strengthening" of "associations" between recti-linearity and a corresponding verbal proposition or "expression"; but also in order to permit a selection process to occur: I.e., to select recti-linearity from the colours, the lengths, the positions, the edges, etc., in which it is embedded.

And all the time, variation or change is combined with something un-changed and well known, in order to produce the conditions for lasting interest and concentration. The word shape is consistently included in order to make possible a sub-ordination of recti-linear to SHAPE, which also denotes bowed, round, circular, squared, spheric and other shapes; i.e., in order to provide conditions for learning the conceptual system of shape.

III.35 The teaching model systematically examplified: PLACE between

It has proved to be appropriate to start with the fundamental conceptual system of COLOUR (red, blue, yellow, green, etc. COLOUR), which usually is the better known by most children; and then pass to the SHAPE system, the system of SIZE concepts of different kinds, the system of NUMBER concepts and NUMBER RELATIONS, etc.

But early also the conceptual system of PLACE relations or LOCATIONS should be introduced (PLACE upon, above, beneath, below, on the side of, on the left hand and right hand side of, between, first, second, third, etc. in a row, etc.). They are all relational concepts and rather difficult to learn, therefore.

The concept of place between (at least two other things) will be used here to more fully examplify the teaching model.

Selective associations

One can start with whatever the actual children would like to look upon, handle and talk about (interest!). If that happens to be model cars, three cars are presented in a

horizontal row - at a table - with the front of each turned towards the children (cars A, B, and C):

A B C
• • •

Then opportunity is first given to express what might be previously learned and can now be "assimilated":"Perhaps some of you have already learned this. Therefore I first ask: Which <u>place</u> does this model car (B pointed out) have as related to the other two cars ?" If an incomplete answer is given, it is given credit for what might be correct in it. But even in that case, an"accomodation"by imitation must take place; that is, in order to learn more precisely: "Can you, Peter (who also easily imitates) point with and repeat after me: <u>This car</u> (both point at B) <u>has place between the two others</u>".

If he fails, he knows that he has many times before learned after continued exercise. The teacher can say, therefore, and will be believed while saying: "This was not easy to say; but try again, and I know that you will be able to do it correctly."

Meanwhile, the other pupils have had the opportunity to "learn by observations" (e.g. BANDURA, 1977). And our experiance is that they prepare for a performance when they observe others, because they know that their time will come soon. They are often able to describe correctly in first trial, therefore. If not, they know that they will have new opportunities to formulate a correct description when new instances of a class are presented. That is, new things or events are used; but <u>the same description applies</u>, since all examples are members of the class of things or events that are <u>placed between two others</u>.

Thus "placed between two other things" applies when the teacher turn the cars in different <u>directions</u>, when the things are placed in a vertical column instead of a horizontal row, when cars are replaced by dolls, by houses, by pictures on the wall, by the pupils themselves, by letters in a

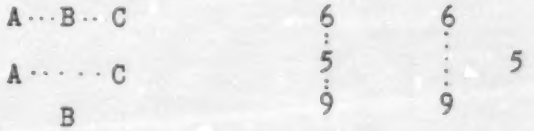
word (six), by digits in a number (375), by sounds in a heard word (place beween in a row of events), etc.

Each time the learner experiences something new or changed - and chosen from what is expected to gratify - that will usually maintain interest and corresponding concentration. Each time the person is also given opportunity to analyze more exactly; and to exercise a precise description. And for each concept, the description is only partially changed: "It has recti-linear shape;" "It has red colour"; "It is placed upon the table"; "It is placed between two other things", etc.

Thus, a "high reliability of observations or measurements" can be obtained in the course of many learning situations presented already in the selective association (SA) phase.

Selective discriminations (SD)

When a high degree - or high reliability - of learning has been achieved, the next step or sub-process can be introduced. Thus, during the elaboration of selective discriminations, members of other, but related classes, which can easily be confused with the proper ones, are introduced; i.e., together with members of the class taught:



"Can you point at that letter (or digit) which is placed between two other letters (or digits)?"And when the correct B (or 5) is chosen, the consequence and further instruction can be: "Fine; you chose the correct one. But can you also tell us why you chose that one?" "Because it is placed between two other letters (digits, etc.)", would then confirm the choice and give the exact reason for pointing out. And the teacher can then eliminate guessing as a possible cause of "hitting" the correct thing.

Again many different instances, sampled among the things or

events that the particular group of children is supposed to appriciate, can be used. And in this phase of the work, the advantages of discrimination learning situations can be utilized. That is; if a pupil refuses to try because he expects a failure, a reward - or a for him positive consequence (S^C+) - can be hidden behind, under or within the correct object. That has often motivated pupils to try even when they are afraid of failures. Or why not use something which the learner might like to eat or drink as stimuli ?

If such "tangible" positive consequence might contribute significantly to a pupil's learning, have we the right not to utilize that kind of chanels ?

Selective generalizations (SG)

When previously working with other concepts and other conceptual systems, the pupil has learned to describe part similarities: "They are all similar in having blue colour (not necessarily similar in colour); "They are all similar in having large size (as related to others)", etc.

Therefore, to state that "all these things (they) are similar in having place between two other things", in the work with selective generalizations, constitutes only a combination of what has been learned earlier; i.e., while learning concepts in the past, and while learning in the SA and SD phases.

When the time for learning "place between" has come, most pupils rather easily master this description in terms of "selected similarities". And it has happened so many times, and in a so high percent of the taught, that one can confidently predict that it will regularly happen again, when children are given the opportunity to learn thoroughly. Even so with children who had considerably failed to learn in advance of the ILF-teaching of concepts (NYBORG (ed.),1982,2).

Selective generalizations are supposed to take place already within the process of selective associations. In the SG-

phase, this detection or discovery of selected similarities are made conscious by means of a description of partial similarities; that is, when faced with many instances, different instances, of the class of staying "between two other things" or "occurring between two other events". The discovery and formu-lation of selected similarities - of conservations - seem to gratify children, as often happens also with grown-up people.

Flexibility of coding and "depth of analysis"

For each conceptual system which has become adequately learned by the pupils, they can be used to analyze or code things and events from an increasing number of "angles" or "points of view". Their attention, which usually started in a "rigid" or "centrated" way of perceiving, can increasingly be replaced by a flexibility of analysis (de-centration), manifested in competent answers to following kinds of questions, asked by others or asked by the children to themselves:

Which colour does this thing (or event) have ?
Which shape has this thing (or this part of the letter) ?
Which size does it have, while related to different other things ?
Which place or location has it when related to other things (or a line, or to other parts of a thing) ?
What is the number of parts, or the number of things or events within groups, etc. ?
For what can it be used ? Or how does it in other ways function ?
Which smell or taste does it have ?
How is it's surface structure ?
Of which substance has it been made ?
Which weight and temperature does it posess ?
etc.

(The reader will notice that the correct answers to this series of questions does not constitute a single or double classification, but rather a multiple classification.)

As learning has proceeded, we have repeatedly been able to confirm the assumptions made by CRAIK & LOCKHART (1972) and NYBORG (1971), that "the better or more exactly a

phenomenon has become analysed by a person, the better can it be learned and remembered; that is, remembered both for a short time (STM) and for a long time (LTM).

And, which is even more important: The better things and events have become analysed, the higher is the probability for being able to selectively generalize or transfer what has previously been learned to future learning. Thus, learning fundamental conceptual systems - and their language skill counterparts - i.e., instrumental language functions (ILF), has provided an increase in readiness for learning many kinds of developmental tasks.

III.4 Analytic coding, selective discriminations and selective generalizations considered as mediating processes in transfer to intelligence tests and new learning tasks; competence and transfer underlying a person's "freedom to learn"

Thus it can be noticed that analytic coding, selective discriminations and selective generalizations all constitute processes which are central mediating processes during transfer of learning. And they do all depend upon that concepts and language skills have been learned to a level which permits a quick activation and use; that is, when the person face new situations to which they apply.

Such situations include both 1) tests, designed to include items partly known and partly new for each person; and 2) learning situations, which are named so because they are presumed to represent something yet not learned by the person. Among tests, designed to be both new and to allow the use of something previously learned and LTM-stored, are also intelligence tests, used to assess a person's present level of "general success or failures of preceding learning" (NYBORG, 1980,2).

If little or no transfer takes place from previous to later tasks, the person's learning is doomed to retardate; otherwisely described: The usual accelleration of learning rate

can not occur; and the accompanying frustrations are likely to cause painful feelings, associated to attempts to learn, to learning-situations and possibly also to the teachers who are present when the negative feelings occur.

Thus, if small transferability of learning and unfavorable emotional and motivational dispositions towards learning situations converge and probably mutually "strengthen" each other during new learning attempts, one cannot expect that new learning can easily take place. The person, then, has rather little freedom to learn, also in the ROGERSIAN sense.

Greater "freedom to learn" can only be obtained, in such cases, by an increase in the transferability of stored experiences; that is, by providing learning that permits increasing analytic coding and selective generalizations and discriminations to take place in the person when facing new learning tasks. And class concepts and conceptual systems, by means of language skills organized into principles, rules, laws, definitions, etc., can be assumed to be the most important mediators of transfer.

Only gradually can the associated negative dispositions toward learning situations be reduced and be replaced by positive feelings of having learned and thereby obtained competence.

Thus, only by obtaining a minimum of competence (WHITE & WATT, 1963) can the person develop a positive self-concept, including a genuin self-control or independence, self-respect, trust in one-self, self-acceptance, etc., all of which lies beneath also an emotional stability.

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